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AVERAGE CASUALTY RATES
(Section III)

Section 2-AD

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Appendix D

SELECTED CASUALTY EXPERIENCE,
25TH DIVISION,
KOREAN WAR

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JAN 19 1972

Part One: The Operational Setting

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Enclosure 1

KOREAN WAR--25TH DIVISION ACTION

In the Korean War US forces again, as in World War II in the Pacific and CBI Theaters, faced oriental enemies. The North Koreans and Chinese Communists exhibited most of the same characteristics that exemplified the Japanese soldier with the exception of invariable fanatical and useless last ditch defenses to the last round and last man. The North Koreans, however, in defending near or north of the 38th parallel tended toward such action.

Operations

The 25th Infantry Division operations under consideration begin with the counteroffensive of September 16, 1950, with the breakout from the Pusan Perimeter coordinated with the Inchon landing. Defense against the last-gasp North Korean attack was followed by several days of attack against heavy resistance which was in turn followed by a week of pursuit with armored task forces in the van which covered up to 200 miles.

Following this was a month of small unit operations in a 6500 square mile area of central South Korea, mopping up NKA remnants and guerrillas. The second week in November was spent in a similar operation against better organized resistance a bit farther to the north but still well behind allied front lines, which were now far into North Korea and pushing to the Yalu River.

Toward the end of November the 25th Division was launched in attack across the Chongchon River north of Kunu-Ri against light resistance--for the first time for the 25th from the Chinese, who had entered the war a month earlier. At the conclusion of this brief attack by the 25th the Chinese began their first major offensive and the 25th went over to the defense for two days, losing about 5% of its strength. There followed a withdrawal of 30 miles, in which the division lost another 5%. Although casualties inflicted upon the enemy were undoubtedly severe there is no contemporary estimate as to the number, and thus this engagement cannot be included in this study.

By mid-January 1951 the allied retreat stopped about 50 miles south of Seoul and the 25th went over to the attack, which lasted

until February 19 and took the division to the Han River. This line was defended for two weeks. Then the 25th attacked across the Han and continued for six weeks until the Kumhwa-Chorwan-Pyonggang "Iron Triangle" was reached. The offensive was halted by the defenses in this area as well as the threat of the impending Chinese April 5th Phase offensive which was anticipated as a result of interrogation of prisoners.

The 25th, under the pressure of this offensive, together with the balance of the allied army, withdrew for four days to a line forward of the Han River and covering crossing sites. Here they defended for three weeks, then again went over to the attack as enemy forces became attritted and extended. The attack was over some of the same ground, at about the same rate of advance of 3000 to 5000 yards per day, and the same tactics were used. This attack again lasted for six weeks and terminated, for the 25th, at the southern edge of the "Iron Triangle." By this time the truce talks were beginning and the allied offensive slowed, particularly against the strongly defended "Iron Triangle" communications center, although continuing in other sectors until mid-September.

Tactics

Characteristic of the enemy tactics were the following:

Hard and long marching, mostly at night, while resting in well camouflaged bivouacs by day, which enabled sudden concentrations and attacks from long approach marches.

Emphasis on night attacks and close combat with disregard for heavy casualties, partially nullifying US firepower superiority.

Holding frontal attacks with massive infiltration through gaps and around flanks with double envelopments of positions, attack of rear installations and supporting artillery positions, and road blocks across US supply routes and lines of retreat.

Excellent use of cover and concealment at all times and rapid and deep digging on defense.

Generally effective use of mortars and machineguns in both attack and defense.

Command and Control

Command and control of the North Koreans and Chinese Communists was weak and at a World War I level. Radio nets generally terminated at the regimental level. Telephone was used from there to battalion and rarely to company, with dependence placed on messengers and preplanning. This latter resulted in an expensive inflexibility at levels below regiment which, coupled with oriental disregard for casualties and with Communist fanaticism, caused ineffective attacks to be continued against unbroken defenses with heavy casualties, often for no gain.

Supporting Arms

While the North Korean Army attacked across the 38th parallel on June 25, 1950, equipped with Soviet divisional artillery on a World War II scale, this had been considerably reduced by counterbattery fires and air attack by the time of the September 16 counteroffensive. The Chinese, on the other hand, during the period under consideration were very weak in artillery by US standards. This weakness was across the board; fewer and lighter guns, inadequate ammunition supply for a variety of materiel, no doctrine or training to mass and shift fires of many battalions across a wide front, and lack of reliable and extensive radio communications for call fires and shifting of fires.

An infantry regiment might have the equivalent of a battery of 70mm. to 76mm. howitzers and/or 81mm. or 120mm. mortars. The infantry division usually had an organic battalion consisting of a battery of 75mm. or 76mm. howitzers or guns plus a battery of 120mm. mortars. An army of three divisions had an artillery regiment generally of up to 36 75mm. or 76mm. guns. An army group of three or more armies assigned the main effort in an offensive was usually reinforced by an artillery division or elements of one. The artillery division had up to five regiments, each with 36 pieces of 75mm. or 76mm. guns, Japanese or US 105mm. howitzers, or Japanese 150mm. howitzers. This wide variety of materiel posed a difficult ammunition resupply problem.

Guns were massed against objectives, and any fire shifts were largely by prearrangement rather than by the US methods of call fires and fire shifts and massing, all accomplished by a combination of radio, materiel which permitted a wide arc of traverse, and a proven and effective doctrine. Thus, while sometimes effective

in the assault of initial objectives, Chinese artillery did not have the ability to support an attack continually through the depth of an allied position, or to shift the weight of fire from one zone of action to another across an attacking division front.

After September 16 enemy tanks, invariably Soviet T34s, were seldom seen and then in platoon strength or less. As a result they were quickly knocked out by US tanks or artillery or, as was more often the case, destroyed by aircraft before they got within range of the ground arms. Enemy aircraft attacked even less frequently and these were usually sneak nuisance raids by one plane against allied units.

Terrain and Defensive Tactics

The terrain in Korea, aside from some rolling coastal plains and narrow river valleys, is generally ruggedly hilly to mountainous. This was ideal for the defender, permitting observation, fields of fire, and a defiladed rear. The narrow valleys could be heavily mined to delay or prevent tank penetration to rear areas, while approaches to hilltop positions were often narrow ridge lines which could easily be covered by defensive fires. As indicated, the North Koreans tended to defend these positions with uniform tenacity, but the Chinese tended to a more flexible defense designed to wear down the opponent by trading terrain for time and drawing the opponent into a weakened and unfavorable position where he could be struck with an effective counterblow. This did not preclude, however, a tenacious defense by an individual Chinese company or battalion to cover the withdrawal of higher units about to be trapped in an unfavorable situation by our rapid advance.

The Chinese thus did not employ at this stage of the war a concept similar to our main line of resistance to be held protected by an outpost line of resistance to warn of attack, attrite the attacker, and confuse him as to the location of the MLR. He termed this flexible defense a "roving defense" and it was entirely compatible with Mao's strategic defensive-offensive which called for drawing the enemy deep into one's own territory while weakening and dividing him, all the while gathering strength for a counterblow. In effect, this is what happened in November 1950 with allied forces drawn deeply into North Korea in pursuit of the broken NKA, only to be hit by massive and fresh Chinese armies while weakened and dispersed across a wide front.

US 25th Infantry Division Organization and Tactics

The 25th Infantry Division generally had the equivalent of an additional RCT--or more--attached. This was usually the Turkish Brigade (2 regiments and 2 artillery battalions) but upon occasion was the 25th Canadian Brigade (equivalent of an RCT), the 29th British Brigade (also RCT equivalent), or a US RCT. Also often attached was the Philippine 10th BCT or a ROKA infantry regiment. In addition to the division's organic tank battalion an additional tank battalion was usually attached.

This additional strength enabled the 25th to operate on frontages of from 15,000 to 25,000 yards and with armored task forces, each built around a tank battalion and an infantry battalion, on two parallel axes of advance. Attacks usually were on a three-regiment front, often with one or two armored task forces operating in valley axes ahead of the main advance over the hills, where the width of the valley and the terrain permitted. The infantry advance was closely coordinated with artillery, air, and tank support. The objective, during the four allied counteroffensives, was the killing of the maximum number of Chinese as much as it was the seizing of key terrain features. Accordingly, when the Chinese made a rapid withdrawal out of contact both to recoup and to draw us out, the 25th would range forward of the MLR or strongly hold patrol bases with heavily supported tank-infantry task forces. These forces would endeavor to overwhelm any Chinese patrols or outposts as well as make spoiling attacks against any Chinese offensive buildup.

US defensive positions during this period would be termed "hasty," consisting of one- and two-man fighting holes, and open crew served weapons emplacements, sometimes connected by shallow communications trenches. This resulted from the mobile nature of the war, with US forces attacking by day and forming a hasty perimeter defense against the enemy's inevitable night counterattack. Alternatively, after an offensive period in which the allies attacked right up to the day for the next enemy offensive deduced by G-2, from POWs and obvious signs, the allies "rolled with the punch" and began a fighting withdrawal to better defensive terrain and to wear down and extend the enemy. US defensive tactics were further characterized by heavy front-line automatic weapons strength, close-in defensive fires by mortars and artillery, counterattacks to recapture key terrain when it was vital to a position to be maintained, deep supporting fires by artillery and air to wear down the enemy and break up attacks in the preparatory phase in the attack and assembly positions and in concentration areas, tied-in flanks

to give warning at least of infiltrations, and a willingness to trade ground for lives.

Methodology

Considerations and procedures related to the selection of engagements, and the development and analysis of US force and casualty data were identical to those earlier described for Okinawa.

The considerations and procedures for development and analysis of North Korean and Chinese Communist strengths and casualties are similar to those for Okinawa, but with some differences. In the first place, opposing overall force strengths and structures are not so well known as was the case on Okinawa. Similarly the casualties are based mainly on estimates. However, intelligence cross-checking, from combat unit level to theater level, do provide considerable confidence that the strength and casualty estimate figures are reasonably accurate. The enemy casualty figures used are those which were determined by Far East Command, on assessment of the various subordinate reports received, and after checking with other information of overall enemy strength and replacements. For our purposes these have been assumed to include wounded and missing as well as killed in action.

Estimates of enemy firepower are somewhat less reliable than those for Okinawa. There was little uniformity of structure and of equipment among the North Korean and Chinese Communist units; their actual weaponry was generally far from consistent with theoretical Tables of Equipment.

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Appendix D

SELECTED CASUALTY EXPERIENCE,
25TH DIVISION,
KOREAN WAR

Part Two: The Engagements

Enclosure 1

KOREA-I--25TH DIVISION, PUSAN PERIMETER DEFENSE, September 16-18, 1950

Posture: Attack against a prepared defense.

During the nights of September 16-17 and September 17-18, night attacks were made by the 6th and 7th North Korean Divisions, with the 83rd Mechanized and 104th Security Regiments, against the 25th US Division, delaying the plans of the 25th to attack. Statistics have been adjusted to include estimated casualties for the defense phase--the night of September 16 through the early morning of September 18.

25th Division Statistics

Manpower

The 25th had an average daily strength of 15,158 during this period. It is assumed that the 10th Philippine BCT was not used during this defense.

Firepower

Of the divisional firepower (799,629,900) it is assumed that 90% was used in the defense, a total of 719,666,900.

Casualties

Casualties were 113 for the period. Since there were two night attacks, it is treated as 1.5 days, giving a casualty rate of 75.2/day, .497% of average daily strength.

6th and 7th North Korean Divisions Statistics

Manpower

Average daily manpower of the two North Korean divisions, plus attachments, is estimated at 10,960.

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Firepower

Theoretical firepower is estimated as follows:

6th North Korean Division	75,089,000
7th North Korean Division	75,089,000
83rd Mechanized Regiment	15,124,000
104th Security Regiment	2,260,000
Total	167,562,000

Actual firepower is estimated at 75% of theoretical firepower, or 125,671,500.

Casualties

North Korean casualties were 480 for the 1.5 day period, or 320/day, 2.92% of average daily strength.

Comparisons

Manpower ratio: $\frac{15,158}{10,960} = \frac{1.383}{1.000}$

Firepower ratio: $\frac{719,666,900}{125,671,500} = \frac{5.725}{1.000}$

Force ratio product: (attacker) $\frac{.1263}{1.000}$

Force ratio product: (defender) $\frac{7.918}{1.000}$

Results: Attack failed; successful defense.

Enclosure 2

KOREA-II--25TH DIVISION, OFFENSIVE FROM PUSAN PERIMETER, September 18-21, 1945

Posture: Attack against withdrawal from hasty defense.

On the morning of September 18, as the enemy attack continued in the 24th Infantry sector, the 35th and 27th Infantry Regiments began the 25th Division attack. By the end of September 19 they had advanced 2000 yards. The 7th North Korean Division then withdrew, while the 6th North Korean Division sideslipped and met attacks of the US 24th and 27th Infantry with strong resistance. On September 20, the 27th and 35th Infantry attacked the 6th North Korean Division and 83rd Mechanized Regiment, meeting heavy resistance from the well dug in and camouflaged enemy forces. The enemy withdrew by day, however. The following day the 35th Infantry advanced 8000 yards and the 24th Infantry 5000 yards, against spotty resistance. An estimated one enemy regiment opposed each regimental combat team.

25th Division Statistics

Manpower

The 25th Division (15,000) plus the 10th Philippine Battalion Combat Team (1026) and one tank battalion (600), had an estimated average strength of 16,626 during this period.

Firepower

Divisional firepower at 90% of strength (719,666,886) was augmented by a tank battalion (295,749,731), the 10th Philippine BCT (estimated at 9,000,000), and a battery of 6 105mm. howitzers (19,334,312), making a total firepower of 1,043,750,900.

Casualties

Casualties were 375 for the four-day period (for the division only), giving a casualty rate of 93.7/day, or .625% of strength.

6th and 7th North Korean Divisions Statistics

Manpower

Estimated average strength of the two divisions, plus attachments, for this period was 10,250 men.

Firepower

Firepower is estimated at 126,300,000.

Casualties

Casualties totalled 940, or 235/day, 2.295% of strength.

Comparisons

Manpower ratio: $\frac{16,626}{10,250} = \frac{1.622}{1.000}$

Firepower ratio: $\frac{1,043,750,900}{126,300,000} = \frac{8.264}{1.000}$

Force ratio product: (attacker) $\frac{13.404}{1.000}$

Force ratio product: (defender) $\frac{.0746}{1.000}$

Results: Successful attack; defense failed; withdrawal unsuccessful.

Enclosure 3

KOREA-III--25TH DIVISION, NAM RIVER OPERATION, September 22-24, 1950

Posture: Attack against delaying action.

On September 22 the North Koreans fought a delaying action, then made a night counterattack. The US regiments attacked against strong defense with heavy support fires, over difficult terrain. The following day the enemy again counterattacked against the 35th Infantry Regiment. All US regiments then advanced against light resistance. Task Force Torman, an armored task force, broke out and pursued the North Korean forces, who abandoned equipment as they withdrew. On the 24th, the 7th North Korean Division fought a delaying action east of the Nam River, and the 35th Infantry received two counterattacks. The 27th Infantry attacked, meeting sporadic resistance. Armored Task Forces Blain and Dolvin were in pursuit.

25th Division Statistics

Manpower

The average daily strength of the 25th Division (14,660), plus attachments, for this period was 16,286.

Firepower

Firepower is estimated as in Korea-II at 1,043,750,900.

Casualties

Casualties for the period were 231 for the three-day period, or 77/day, .526% of average daily strength of the division.

6th and 7th North Korean Divisions Statistics

Manpower

Average strength for the period is estimated at 8,960.

Firepower

Firepower of the North Korean force is estimated at 60% of a theoretical firepower of 167,562,000, or 100,537,200.

Casualties

Casualties were 1640, or 547/day, 6.11% of strength.

Comparisons

Manpower ratio: $\frac{16,286}{8,960} = \frac{1.818}{1.000}$

Firepower ratio: $\frac{1,043,750,900}{100,537,200} = \frac{10.381}{1.000}$

Force ratio product: (attacker) $\frac{18.873}{1.000}$

Force ratio product: (defender) $\frac{.0530}{1.000}$

Results: Successful attack; unsuccessful delaying action (which became a withdrawal).

Enclosure 4

KOREA-IV--25TH DIVISION, PURSUIT THROUGH KUNSON, September 25-30, 1950

Posture: Attack against withdrawal from hasty defense.

The 25th Division continued in pursuit to seize Kunson, sometimes meeting heavy resistance. As the attack and pursuit continued, the enemy continued to withdraw, leaving behind dead and equipment.

25th Division Statistics

Manpower

25th Division average manpower for the period is estimated at 14,595, a total of 16,221 with attachments.

Firepower

Firepower continued at 1,043,750,900.

Casualties

Casualties were 104, or 17.33/day, .119% of average daily strength of the division.

6th and 7th North Korean Divisions Statistics

Manpower

6th and 7th Division manpower is estimated at an average of 7,085 for the period.

Firepower

Firepower is estimated at an average 40% of theoretical firepower, 167,562,000, or 67,024,800.

Casualties

North Korean casualties during the period were 1350, or 225/day, 3.18% of strength.

Comparisons

Manpower ratio: $\frac{16,221}{7,085} = \frac{2.289}{1.000}$

Firepower ratio: $\frac{1,043,750,900}{67,024,800} = \frac{15.557}{1.000}$

Force ratio product: (attacker) $\frac{35.610}{1.000}$

Force ratio product: (defender) $\frac{.0281}{1.000}$

Results: Successful attack; unsuccessful defense; partly successful withdrawal.

Enclosure 5

KOREA-V--25TH DIVISION, CROSSING OF THE HAN RIVER, March 7-9, 1951

Posture: Attack against a prepared position.

On March 7 the 25th Division crossed the Han River against enemy mortar and artillery fire, with strong artillery support. Advance was continued on March 8 against light enemy resistance. Opposing the crossing were the 114th Division, 38th Army, and the 150th Division, 50th Army.

25th Division Statistics

Manpower

Estimated average daily strength of the 25th Division was 15,792. With the attached Turkish Brigade and a tank battalion, total manpower was 25,516.

Firepower

Firepower is estimated as follows:

Divisional firepower	799,629,874
Turkish Brigade	73,570,000
Tank battalion	295,749,731
Air support	30,000,000
Artillery support	46,868,900
Total	1,245,818,500

Casualties

25th Division casualties were 250, or 83.3/day, .528% of average daily strength.

38th and 50th Army Statistics

Manpower

Estimated average daily strength of the engaged elements of the two Chinese armies was 27,000.

Firepower

Firepower is estimated at 266,800,000.

Casualties

Casualties for the period were 6115, or 2038.3/day, 7.549% of daily strength.

Comparisons

Manpower ratio: $\frac{25{,}516}{27{,}000} = \frac{.945}{1.000}$

Firepower ratio: $\frac{1{,}245{,}818{,}500}{266{,}800{,}000} = \frac{4.669}{1.000}$

Force ratio product: (attacker) $\frac{4.412}{1.000}$

Force ratio product: (defender) $\frac{.2265}{1.000}$

Results: Successful attack; unsuccessful defense.

Enclosure 6

KOREA-VI--25TH DIVISION, ATTACK TOWARD "BUTTE" LINE, February 3-7, 1951

Posture: Attack against hastily prepared position.

The 25th Division with attachments (TAFC--a Turkish Brigade, 15th ROKA Regiment, 89th Tank Battalion) continued advancing against moderate enemy resistance from the 148th Division of 50th CCF Army and 8th NK Division of II NK Corps. In addition to the other enemy units the 47th NK Division was also committed to action on the 5th of February. Enemy resistance increased on the 7th. The division advanced 3-4,000 yards.

25th Division Statistics

Manpower

The 25th Division with reinforcements had an estimated average strength of 29,006 during this period.

25th Division	16,282
Turkish Brigade	9,124
15th ROK Regiment	3,000
89th Tank Battalion	600
Total	29,006

Firepower

Total firepower for the division and attached units is estimated as follows:

25th Division	799,629,874
89th Tank Battalion	295,749,731
Turkish Brigade (2 regiments, 2 artillery battalions)	73,570,000
15th ROK Regiment	25,000,000
Air support	180,000,000
Total	1,373,949,600

Casualties

25th Division casualties for the five-day period were 303, or 60.0/day, .367% of strength.

148th Division, 50th CCF Army and 8th and 47th NK Division, II NK Corps Statistics

Manpower

Average manpower of one Chinese division and two North Korean divisions is estimated at 30,200.

Firepower

Firepower is estimated as follows:

8th ar ˋ 47th NK Division	135,000,000
148th CCF Division	178,550,000
Total	313,550,000

Casualties

For the five-day period, casualties were estimated at 15,805, or 3161/day, 10.466% of average daily strength.

Comparisons

Manpower ratio: $\frac{29,006}{30,200} = \frac{.960}{1.000}$

Firepower ratio: $\frac{1,373,949,605}{313,550,000} = \frac{4.382}{1.000}$

Force ratio product: (attacker) $\frac{4.207}{1.000}$

Force ratio product: (defender)	$\frac{.2377}{1.000}$

Results: Successful attack; unsuccessful defense.

Enclosure 7

KOREA-VII--25TH DIVISION, ATTACK TOWARD THE CHAN RIVER,
April 3-5, 1951

Posture: Attack against a hasty defense.

From April 3-5, the 25th Division, with a Turkish Brigade and a tank battalion attached, attacked toward the Chan River, opposed by two divisions of the Chinese 26th Army.

25th Division Statistics

Manpower

The average daily strength of the 25th Division (16,297) plus attachments of the Turkish Brigade (9124) and the 89th Tank Battalion (600) was 26,021 during this period.

Firepower

Total firepower is estimated at:

25th Division	799,629,874
Turkish Brigade	73,570,000
Air support	180,000,000
89th Tank Battalion	295,749,731
Total	1,348,949,600

Casualties

25th Division casualties for the period were 151, or 50.3/day, .308% of strength.

CCF 26th Army Statistics

Manpower

Average strength for this period is estimated at 12,532.

Firepower

Firepower is estimated at 60% x two divisions (70,000,000 each) and an artillery regiment (21,400,000). The total firepower is calculated to be 96,840,000.

Casualties

CCF casualties were 1558, or 519.3/day, 4.143% of strength.

Comparisons

Manpower ratio: $\frac{26,021}{12,532} = \frac{2.076}{1.000}$

Firepower ratio: $\frac{1,348,949,600}{96,840,000} = \frac{13.93}{1.000}$

Force ratio product: (attacker) $\frac{28.919}{1.000}$

Force ratio product: (defender) $\frac{.0346}{1.000}$

<u>Results</u>: Successful attack; unsuccessful defense.

Enclosure 8

KOREA-VIII--25TH DIVISION, WITHDRAWAL TO "KANSAS" LINE, April 23-27, 1951

Posture: Attack against delaying action.

On April 23, the 179th Division of the CCF 60th Army and the 34th and 36th Divisions of the 12th Army launched a strong offensive against the 25th Division. The American units fought a delaying action as most of the 25th Division was withdrawing to the "Kansas" Line.

25th Division Statistics

Manpower

The estimated average strength of the 25th Division was increased by replacements to 17,075. Attachments of the Turkish Brigade (9124) and the 89th Tank Battalion (650) made a total strength of 26,849.

Firepower

Firepower is estimated as continuing at 1,348,949,600.

Casualties

25th Division casualties for the period were 466, or 93.2/day, .546% of strength.

60th and 12th Army Statistics

Manpower

Estimated average strength of the three infantry divisions plus an artillery division for this period was 35,136.

Firepower

The combined firepower strength of the three infantry divisions (225,267,000) and the artillery division (56,800,600) gives a total firepower strength of 282,067,600.

Casualties

Casualties for the period were 5728, or 1145.6/day, 3.26% of strength.

Comparisons

Manpower ratio:	$\frac{26,849}{35,136} = \frac{.764}{1.000}$
Firepower ratio:	$\frac{1,348,949,600}{282,067,600} = \frac{4.782}{1.000}$
Force ratio product: (attacker)	$\frac{.2737}{1.000}$
Force ratio product: (defender)	$\frac{3.653}{1.000}$

Results: Unsuccessful attack; successful delaying action.

Enclosure 9

KOREA-IX--25TH DIVISION, ATTACK TOWARD LINE "PIERCE," May 20-23, 1951

Posture: Attack against a hastily prepared position.

The 25th Division advanced almost 5000 yards before contacting and attacking enemy forces, CCF 64th and 65th Armies. The attack continued the following day with the division advancing 4-6000 yards against light to heavy resistance. On May 22 the division advanced 4-6000 yards to Line "Pierce." There was light contact with the enemy. Tank and infantry patrolled to the Sonzu River (8000 yards) on the 23rd, engaged an enemy force, and returned to division lines.

25th Division Statistics

Manpower

Estimated average daily strength for the 25th Division (18,137) with reinforcements consisting of a Turkish brigade (9,124) and the 89th Tank Battalion (650) was 27,861.

Firepower

Total firepower for the division and attached units is estimated as continuing at 1,348,949,600.

Casualties

Casualties for the four-day period were 170, or 42.5/day; .234% of average daily strength.

64th and 65th CCF Armies Statistics

Manpower

Estimated average daily strength for the two armies plus an artillery division is 38,000.

Firepower

Total firepower for the two armies plus an artillery division both estimated at 60% of normal strength is 304,400,800.

Casualties

Total casualties for the two armies were 4777, or 1194.3/day, 3.143% of strength.

Comparisons

Manpower ratio: $\frac{27,861}{38,000} = \frac{.733}{1.000}$

Firepower ratio: $\frac{1,348,949,600}{304,400,800} = \frac{4.431}{1.000}$

Force ratio product: (attacker) $\frac{3.248}{1.000}$

Force ratio product: (defender) $\frac{.3079}{1.000}$

Results: Successful attack; unsuccessful defense.

Enclosure 10

KOREA-X--25TH DIVISION, IRON TRIANGLE DEFENSE, June 1-2, 1951

Posture: Attack against a hastily prepared position.

On June 1 and 2, the division maintained defensive positions against enemy probes (CCF 63rd Army). There was light contact, some local counterattacks against elements of the division, and some heavy artillery and mortar fire against regimental units. The enemy engaged in some probes and directed harassing fire at elements of the division.

25th Division Statistics

Manpower

The 25th Division less one regiment had an estimated average strength of 13,790.

Firepower

Firepower of the division less one regiment, with light air support, is estimated at 699,629,800.

Casualties

Casualties for the period were 152, or 76/day, .551% of strength.

63rd CCF Army Statistics

Manpower

The estimated average strength of three divisions and one-half artillery division is 37,000.

Firepower

Firepower for the three divisions of the 63rd CCF Army (225,267,000) plus one-half artillery division (28,400,000) is 253,667,000.

Casualties

Casualties for the period were 1400, or 700/day, 1.89% of strength.

Comparisons

Manpower ratio: $\frac{13,790}{37,000} = \frac{.372}{1.000}$

Firepower ratio: $\frac{699,629,800}{253,667,000} = \frac{2.758}{1.000}$

Force ratio product: (attacker) $\frac{.9746}{1.000}$

Force ratio product: (defender) $\frac{1.026}{1.000}$

Results: Unsuccessful attack; successful defense.

Enclosure 11

KOREA-XI--25TH DIVISION, ATTACK TOWARD LINE "BAYONET," June 3-5, 1951

Posture: Attack against prepared positions.

From June 3-5, the 25th Division was attacking the CCF 63rd Army, encountering light to moderate resistance. The Chinese counterattacked during the nights of June 4-5 and June 5-6.

25th Division Statistics

Manpower

Estimated average daily strength of the 25th Division less one regiment is 13,665.

Firepower

Firepower of the division less one regiment, with substantial air support, is 729,629,800.

Casualties

Casualties for the period were 236, or 78.7/day, .576% of strength.

63rd CCF Army Statistics

Manpower

The average daily strength, 1500 less than the preceding period, is estimated as 35,500.

Firepower

Firepower is estimated at 5% less than during the preceding period, a total of 240,993,200.

Casualties

Casualties for this period were 3155, or 1051.7/day, 2.96% of strength.

Comparisons

Manpower ratio:	$\frac{13,665}{35,500} = \frac{.385}{1.000}$
Firepower ratio:	$\frac{729,629,800}{240,993,200} = \frac{3.027}{1.000}$
Force ratio product: (attacker)	$\frac{1.165}{1.000}$
Force ratio product: (defender)	$\frac{.8583}{1.000}$

Results: Successful attack; unsuccessful defense.

Appendix E

ORIGINAL HERO STUDY PROPOSAL
FOR STUDY ENTITLED

AVERAGE CASUALTY RATES FOR WAR GAMES,
BASED ON HISTORICAL COMBAT DATA

AVERAGE CASUALTY RATES FOR WAR GAMES,

BASED ON HISTORICAL COMBAT DATA

A HERO Study Proposal

Study Objective

The Historical Evaluation and Research Organization proposes to develop average casualty rates for use in war game models of modern, nonnuclear war, based upon loss experience in World War II and the Korean War. These rates would be primarily designed for application to the Theater War Game Model now being developed by the Research Analysis Corporation (RAC) for the Joint War Games Agency in its project to develop a Revised Theater Battle Model (TBM-68). These rates could also be applied, possibly with some modifications, to other models under development in the TBM-68 project.

Background

RAC is currently undertaking research designed to revise, improve, and simplify the limited war gaming model known as TBM-63. Within the scope of this project it is intended to produce the following specific game models: Theater War Game Model; Theater Quick Game Model; Division Operations Model; Amphibious Warfare Model; and Counterguerrilla Warfare Model. Of these the Theater War Game Model is the most comprehensive and, presumably, will be elaborated in the most detail. RAC requires casualty rates for use in developmental games by 1 February 1967.

HERO has recently completed a study for RAC entitled "Historical Analysis of Wartime Replacement Requirements; Experience for Selected Major Items of Combat Equipment." A major element of this study was to relate combat equipment losses to personnel

casualties in a variety of combat postures from historical experience in World War II, the Korean War, and (to a limited extent) from World War I. Voluminous data for personnel and equipment losses for specific American units over precise periods of time were collected for a number of units in several major theaters of the war. In all instances where personnel losses and equipment losses could be directly correlated, this data is contained, and analyzed exhaustively, in HERO's report on that study, dated 26 July 1966. A substantial amount of additional casualty data, which could not be adequately related to equipment losses, was not presented in that report, but is still available in HERO files.

Included in this casualty data is adequate information to provide a number of documented cases of casualty experience of American forces in five of the six postures for which RAC desires casualty rates: attack, defense of prepared positions, hastily prepared defense, withdrawal, and delaying action. This experience can be related to varying types of terrain (which can be generally aggregated as "favorable to defense," "favorable to attack," and "neutral terrain"). There is no data in this collection for defense of fortified positions by American troops. There are, however, numerous examples of attack by American forces of fortified positions, and this, taken together with data which can be collected with respect to enemy forces and casualties, will permit preparation of adequate casualty rates inflicted by, and sustained by, forces in this posture.

Study Concept

As suggested by the previous paragraph, in order to provide adequate casualty rates related to opposing force ratios, HERO will have to augment its data on American units with comparable data for enemy units in the same engagements. These sets of data will then have to be correlated, analyzed, and structured into adequate representations of average loss rates. RAC will require these rates in the form of curves applicable to the development of its models; HERO would either provide the curves, or casualty data so presented and organized that it can be readily translated into the curve format desired by RAC.

Operational Work Plan

All of the detailed casualty data available in HERO for American forces in World War II and the Korean War will be reviewed, and broken into discrete engagement increments by division or (where data is for larger units) the division portion of a carefully calculated division slice. These unit-engagements will then be entered into a basic table on one side or the other of a double-column Posture Form, which will show attacker and defender under each of the six postures stipulated: attack, defense of fortified position, defense of prepared position, hasty defense, withdrawal, and delaying action.

Intensive research will then be undertaken to obtain the unit designations and force strength (including weapon strength) of the enemy forces involved in each of these unit-engagements. This will be the most time-consuming portion of the work, but since the researchers will know the sources from which the American data has been collected, and since the major aspects of the engagement are already recorded, the research task will be simplified.

When the data has been assembled, that relating specifically to each engagement will be analyzed, on the basis of the general historical record of the course and nature of the engagement, to permit further categorization in the following respects: intensity of engagement, force ratio, and terrain. Within each of these categories the engagement will be rated within one of the following aggregated subcategories:

<u>Intensity</u>: High intensity, low intensity, moderate intensity. Tentatively, the Intensity of Conflict Indices derived by HERO in its "Replacement Requirements" study will be used to determine which of these subcategories applies.

<u>Force Ratio (for attacker)</u>: 10-1 (or more), 5-1, 2-1, approximately equal.

<u>Force Ratio (for defender)</u>: Approximately equal, 1-2, 1-5, 1-10 (or less).

The specifics of the force ratio subcategorization can only be suggested at this time; it is very likely that the experience data will suggest certain other force ratios as being particularly critical. In our examination of the historical evidence we will attempt to determine the weapons actually brought to bear in the

various situations in order to avoid possibly misleading conclusions about ICE's based on a strength and T/E comparison.

Terrain: Favorable to attacker, favorable to defender, neutral terrain.

It is possible that, as already suggested above for force ratios, analysis of the raw data will suggest need for modification in the approach or in the categorization and subcategorization. If such need should appear evident during this analysis, this will be brought to the attention of cognizant officials of RAC, in order to assure that any new or modified approach will be consistent with other aspects of the game models.

Once this compilation, analysis, and categorization is completed, HERO will--if time is available and if this is desired--organize the material into a number of curves. It is currently estimated that about 72 separate charts will provide the information in the most simple and easily applicable form. An example of how one such chart might look is indicated in Appendix A. It will be seen, therefore, that approximately 12 such charts will be required for each of the six postures, to reflect possible permutations of posture, force ratios, and terrain. Each of these charts would include three curves, showing casualties inflicted over time engaged for each of the three subcategories of intensity of conflict.*

It must be emphasized again that the results derived from analysis of the data, and from further study of the problems of presenting this data, may suggest a different approach in the presentation of the data. Whatever form it is presented in, however, will be designed to present the kind of information suggested above, in a form most suitable to RAC purposes. Close and frequent liaison will be maintained with RAC in order to assure this.

In this regard the data produced should be applicable to all levels of force resolution. It will be amenable to computer use. Although not synonymous with ICE, it is believed that the data will be susceptible of being factored into ICE calculations.

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*It is expected that there would only be two curves for the delay posture charts, and possibly only two for the withdrawal charts.

In the light of the short time available, and the limitations which have been placed upon the allocation of effort as a result of informal conversation with RAC officials, it is possible that the data and/or curves submitted to RAC will require subsequent refinement. However, within the available effort, HERO will endeavor to provide a complete and fully substantiated product. Furthermore, to the extent time and effort permit, HERO hopes to be able to submit comments on the various models for TBM-68, in such matters as the following:

a. Application of the concept of Theoretical Lethality Indices (as developed in HERO's study, "Historical Trends Related to Weapon Lethality") to improved firepower scores and casualty and neutralization effects;

b. Application of qualitative variables to war gaming techniques, to improve realism and usefulness of war game results.

Personnel

Appendix B contains a list of Associates and Special Consultants who have been invited to participate in this study, if the contract is awarded. Attached to that appendix are resumes of each individual listed.

Tentative allocation of tasks to the study participants is shown on the Allocation Chart, Appendix C.

Budget

Appendix D contains the tentative Budget for carrying out the proposed study in accordance with the concept and work plan indicated above. This provides for a total of 148 professional man-days of effort, at a total cost of $19,677. It is understood that RAC has available only the equivalent of three to six man-months of effort for this project. It will be noted, however, that 40 of the man-days allocated are for research assistants, whose reimbursement is only about one-quarter that of the senior scholars involved in the study. Furthermore, as suggested above, it is believed that the effort indicated is the minimum possible to achieve the study objectives.

Appendix F

EXCERPT FROM HERO STUDY REPORT

"Historical Trends Related to Weapon Lethality"

(Annex Volume III-H) See AD 458-759

The Inherent Lethality of Weapons

Theoretical Considerations

The following is the definition of weapon lethality suggested to HERO by the Chairman of AVTAC in a letter to HERO, dated July 24, 1964:

> Weapon lethality: the inherent capability of a given weapon to kill personnel or to make materiel ineffective in a given period of time, where capability includes the factors of weapon range, rate of fire, accuracy, radius of effects, and battlefield mobility.

In the light of this definition, we have attempted to ascertain the inherent (or potential or theoretical) lethality of all important weapons in history on a basis that would permit some kind of relative comparison of such weapons. Any approach permitting a relative comparison of weapons, however, requires establishing some sort of relationship between theoretical considerations and practical effects. Yet inherent lethality and actual battlefield lethality effects do not appear, at first blush, to be relatable in practical, precise, and generally applicable terms. The lethality of a weapon in actual use involves many variables, such as terrain, weather, morale, differing states of training, different qualities of leadership, and the like, which cannot be given precise values in any purely theoretical analysis.* Thus any attempt to mix the theoretical and practical aspects of weapons effects might seem to lead to logical inconsistency.

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* Values can, of course, be given to such variables for wargaming purposes, or for other limited, specific purposes. Such values, however, will not have general applicability.

Yet these do appear to be reasons why it would be helpful if the two concepts could be advantageously used together. For instance, it is clear that it will not be possible from historical data to allocate casualties precisely in any battle to different weapons; we do not know exactly how many were killed at Austerlitz by cannon, by musket fire, by bayonet, by cavalry lance, or saber; it is even more difficult to estimate how many among the "missing" surrendered or deserted for fear of specific weapons. Data is slightly more complete for wars of the 20th Century, but still is far from precise. The best we can do is to estimate proportions of casualties on the basis of vague and incomplete evidence (as has been done in Part Two of this paper).

If, however, one is able to ascertain that battlefield lethalities of specific weapons are in some way proportional to the inherent lethalities--from which the variables are eliminated--it would become possible algebraically to allocate the casualties in a specific battle, if one knows how many weapons of each type were used there. There is even a self-checking feature; actual battle casualties can never be negative but algebraic solutions can--if one gets a negative solution he is warned that at least one of the assumptions or data is wrong. The results of such combined-concept algebra might not be right but they at least would be objective and more probable than arbitrary assignments. We think we have moved a long step toward being able to do this.

Having arrived at such a relationship between theoretical and actual lethality, one might even be able to divide the inherent lethality of a given weapon, or of the weapons system, used in a battle, by the calculated battlefield lethality and obtain an effectiveness factor. We have not progressed far enough to do this in this study, but we hope it can be done in the near future. If it should turn out that this factor varies little from weapon to weapon and from time to time, it will be interesting and useful to see how this index can be correlated with the technology of different eras.

The Factors of Lethality

The AVTAC definition suggests that factors to be considered in any quantification effort should include: range, rate of fire, accuracy, radius of effects, and battlefield mobility. Our investigation supports the validity of these as factors to be considered (though with some qualifications) and suggests that the following additional factors also must be considered in any

development of inherent or theoretical lethality capability: number of potential targets rendered ineffective, relative incapacitating effect, reliability, and "overkill." Each of these is considered below:

1. Rate of fire. (For hand-to-hand or pre-gunpowder missile weapons, this would include the number of blows, thrusts, strokes, shots, etc.) This we consider to be the number of effective strikes which a weapon, under ideal conditions, can deliver in a given period of time. We have selected one hour for this purpose, for several reasons, including: (a) this permits consideration of sustained rates of fire for missile weapons; (b) it may permit a comparison with actual, battlefield lethality or effectiveness, testing the assumption that over history one hour per day has been the average direct involvement of individual fighters engaged in important battles. We have taken into consideration common human and technical considerations that would affect rate of fire; we have ignored the logistical problem.

2. Number of potential targets per strike. (This, of course, includes consideration of radius of effects for appropriate weapons.) Most individual weapons throughout history, whether pre-gunpowder missile or hand-to-hand weapons, or firearms of the past five or six centuries, can be expected to hit no more than one individual enemy with each blow or strike, regardless of the extent to which the enemy formation is massed or dispersed. Some weapons, however, have had the capability of incapacitating more than one enemy per stroke, and in order to establish a basis for comparison of the relative theoretical lethality of such weapons, it is essential to establish a standard of target density. We have assumed, therefore, that the comparison can best be made for men in mass formation, each individual occupying an area of four square feet. This permits not only consideration of the relative theoretical lethality of high-explosive shells, but also of the multiple casualty possibilities of the nonexplosive solid cannon ball derived from the combination of its muzzle velocity and weight. (For this purpose we have arbitrarily assumed that the number of individuals in massed formation who could be incapacitated by a single cannon ball would be directly proportionate to the weight of the cannon ball in pounds; thus a 12-pound shot could be expected to mow down a file of 12 soldiers in mass formation.)

3. Relative incapacitating effect. This permits consideration of the fact that blows from some weapons are more likely to be lethal, or incapacitating, than others. Thus statistically

it has always taken several blows from a sword to kill an opponent or to put him out of action for the duration of an engagement. A hit from a cannonball has almost always been incapacitating; a hit from a modern rifle bullet is likely to incapacitate an opponent, but its effect is less certain than the nearby explosion of a high-explosive shell. Suitable factors have been selected in each individual case to reflect the average historical likelihood of an individual blow, hitting a target, to incapacitate the target. (The factors used in this study are not precise, being indicative only, but can be refined by detailed review of suitable records.)

4. Effective Range. This is a difficult factor to handle. It has been suggested that the theoretical lethality of a weapon is in no way affected by its range, so long as it is employed within the limits of its effective range. This would preclude, of course, any comparison of weapons of markedly different range characteristics. The whole purpose of this exercise, however, is to attempt to develop a means of comparing the lethality of weapons of markedly differing characteristics. Furthermore, the AVTAC definition requires consideration of this factor, if a suitable basis for doing so can be ascertained.

There can be no question that a weapon's range has some effect on its practical lethality; certainly a swordsman is put in serious jeopardy by a foe armed with a bow or a gun long before he is in a position to use his sword. Furthermore, history proves conclusively that weapons with greater effective range have been more practically lethal than those with shorter range. This being the case, it seems to be undeniable that one theoretical, as well as practical, effect of range is to give that weapon more opportunity to be lethal or incapacitating than one of shorter range.

There is another important consideration in the range effect of missiles: this is to force all enemies within the effective range of a weapon to take some kind of passive or active countermeasures to protect themselves from the effect of this weapon's employment within its effective range. As a minimum, when a missile weapon is employed, it will force an enemy to take cover, or falter, or to otherwise reflect natural human fear--even though this fear may to some extent be controlled by discipline.

We have not yet arrived at a fully satisfactory means of reflecting this range, but obviously a sliding scale of distance must be used; the problem is to make it slide smoothly and

logically. We have decided to establish as a norm for range the length of a man's arm, which we call Normal Range, with a value of 1, or of 1 yard. This permits us to derive the formula:

(1) Range factor = $1 + \sqrt{k \times \text{Effective Range}}$. Somewhat arbitrarily and intuitively we established the constant k as .001, thus permitting a simple calculation using the range in thousands of yards. Until k can be determined more precisely from analysis of battle or proving ground data, this has seemed suitable. Accordingly we have for the time being rejected another selected formula, which also looks plausible, but is more complicated:

(2) Range factor = $\text{Normal Range} + k \log \left(1 + \frac{\text{Effective Range}}{\text{Normal Range}}\right)$

Formula (1) has given results quite consistent with the apparent lethality relationship of the weapons considered.

It should be noted, also, that determination of an "effective range" is not simple. It has been suggested that we should consider both mean range and maximum effective range, deriving different lethality indices for each; we have avoided this, however, as being unduly cumbersome and complex; our objective is to obtain factors and lethality indices which are reasonably accurate, while avoiding efforts at precision which are in effect more precise than our relatively inexact basic data would really warrant.

5. Accuracy. This is the probability that a single blow, aimed precisely at the target, will hit the target. This is a reflection of the inherent qualities of the weapon, and not the user, since human accuracy can be affected by practice, training, excitement, etc. To some extent accuracy will vary inversely with the range--and this is certainly so for any individual weapon and generally within different weapons of the same type. However, the degree to which accuracy varies will be very different between different weapons. Thus it cannot be expressed as a direct reflection of range, but must be based upon the actual performance of weapons. We have tried to apply accuracy factors based upon hit probabilities at mean battlefield ranges.

6. Reliability. This is the factor which takes into consideration such things as misfires, duds, jamming, and the like. Increasing reliability has historically been a significant factor in the technical improvement of firearms, and this is given due weight in our calculations.

7. Battlefield Mobility. This is perhaps the most difficult factor of all to apply to our consideration of theoretical lethality. Mobility is very dependent upon a number of variable factors. We have rejected the idea that capability of a weapon to move about the battlefield will affect its actual battlefield lethality but not its theoretical or inherent lethality. We have arbitrarily decided that the relation of mobility to the other factors considered may be suitably represented by the product of the weapon's theoretical lethality (based upon its stationary characteristics) and the square root of its speed in miles per hour.

8. Fighting Machine Capability. We believe that the concept used in applying battlefield mobility for a single weapon may be adapted to the mobile fighting machine, such as a tank or fighter-bomber, which carries more than one weapon and which also can absorb punishment. This is done by adding the basic lethality indices of all weapons carried by the machine, and multiplying this sum by the square root of the machine's rated cross-country or normal operating speed in miles per hour. An approximation of its ability to absorb punishment is obtained by adding the lethality of the most effective weapon which has no more than a 50% probability of incapacitating the machine with a single hit.

9. "Overkill." We have seriously considered applying an "overkill" factor for such weapons as machine guns and high-explosive projectiles, since these have a tendency to inflict more than one incapacitating wound on a single foe. Certainly there is an enormous and increasing waste of potentially lethal forces through dissipation in the spaces between targets, absorption by inert earth or unprofitable targets, and multiple strikes upon the same target. We have decided, however, not to include this factor, though we believe its effects should be given further serious consideration in future studies. The efficiency with which a weapon performs its lethal or incapacitating work does not now seem to us to be relevant to the issue at hand.

The Determination of Theoretical Weapon Lethality Indices

From the factors discussed above, it is possible to establish theoretical weapon lethality indices for any given weapon of any characteristics. We believe that these indices, in fact, provide reasonably good comparisons of the relative lethality of any two or more weapons.

It should be emphasized that these are indices, to show relative lethality of different weapons and are not tied to rates of fire, periods of time, areas of ground, or the like, even though we may have used such considerations (among others) to develop the indices. The computations for the calculation of lethality indices for a number of important weapons, including all of those considered elsewhere in this report to have had a significant effect upon military affairs, are indicated below:

Hand-to-hand weapons. We have assumed that approximately 100 blows, strokes, or thrusts could be made by skillful individuals with most hand-to-hand weapons. Though there could be differences in minor respects between some of the factors in the cases of different weapons, we have considered that these are likely to be so slight, and to be so mutually offsetting, as not to warrant consideration. The calculations below, then, are for such weapons as pikes, swords, battle-axes, and the like, with no consideration of tactical employment, or effectiveness against possible countermeasures or evasive actions, under ideal circumstances, and assuming that there would be a target available against which each blow could be directed:

1. Rate of fire: 100
2. Targets per strike: 1
3. Relative effect: .2 (arbitrarily assuming one blow in five to be incapacitating)
4. Effective Range: 1 (within effective reach, wielded by hand)
5. Accuracy: 1 (obviously every hand-to-hand weapon has inherently perfect accuracy)
6. Reliability: 1 (all hand-to-hand weapons have inherently perfect reliability)

(Factors 7 and 8 are not applicable)
Calculation: 100 x .2: or a Lethality Index of 20

Javelin

1. Rate of fire: 80
2. Targets per strike: 1
3. Relative effect: .25
4. Effective range (20 yards): 1 plus $\sqrt{.2}$, or 1.14
5. Accuracy: .8 (an arbitrary figure, which may be high)
6. Reliability: 1

Calculation: 80 x .25 x 1.14 x .8: or 18

Ordinary Bow

1. Rate of fire: 100
2. Targets per strike: 1
3. Relative effect: .2
4. Effective range (100 yards): 1 plus $\sqrt{.1}$, or 1.316
5. Accuracy: .8
6. Reliability: .95 (to consider possibility of faulty bowstrings, or arrows)

Calculation: 100 x .2 x 1.316 x .8 x .95: or <u>20</u>

Longbow

1. Rate of fire: 100
2. Targets per strike: 1
3. Relative effect: .3
4. Effective range (250 yards): 1 plus $\sqrt{.25}$, or 1.5
5. Accuracy: .8
6. Reliability: .95

Calculation: 100 x .3 x 1.5 x .8 x .95: or <u>34</u>

Crossbow

1. Rate of fire: 60
2. Targets per strike: 1
3. Relative effect: .5
4. Effective range (150 yards): 1 plus $\sqrt{.15}$, or 1.387
5. Accuracy: .8
6. Reliability: .95

Calculation: 60 x .5 x 1.387 x .8 x .95: or <u>32</u>

Arquebus

1. Rate of fire: (Theoretically 30-40, but necessary cleaning of fouling would reduce this by about 1/3) 25
2. Targets per strike: 1
3. Relative effect: .75
4. Effective range (100 yards): 1 plus $\sqrt{.1}$, or 1.316
5. Accuracy: .65
6. Reliability: .65

Calculation: 25 x .75 x 1.316 x .65 x .65: or <u>10</u>

17th Century Musket

1. Rate of fire: (Theoretically 60, but necessary cleaning of fouling would reduce this by about 1/3) 40
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (150 yards): 1 plus $\sqrt{.15}$, or 1.387
5. Accuracy: .6
6. Reliability: .7

Calculation: 40 x .8 x 1.387 x .6 x .7: or 19

18th Century Flintlock

1. Rate of fire: (Theoretically 180, but necessary cleaning, and changing of flints would reduce this by about 40%) 110
2. Targets per strike: 1
3. Relative effect: .7
4. Effective range (100 yards): 1 plus $\sqrt{.1}$, or 1.316
5. Accuracy: .6
6. Reliability: .8

Calculation: 110 x .7 x 1.316 x .6 x .8: or 47

Early 19th Century Rifle

1. Rate of fire: (Theoretically 60, but necessary cleaning would reduce this by about 1/3) 40
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (300 yards): 1 plus $\sqrt{.3}$, or 1.547
5. Accuracy: .8
6. Reliability: .9

Calculation: 40 x .8 x 1.547 x .8 x .9: or 36

Mid-19th Century Rifle with Conoidal Bullet

1. Rate of fire: (Theoretically 180, but necessary cleaning would reduce by about 20%) 150
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (600 yards): 1 plus $\sqrt{.6}$, or 1.775
5. Accuracy: .8
6. Reliability: .9

Calculation: 150 x .8 x 1.775 x .8 x .9: or 154

Late 19th Century Breech-loading Rifle

1. Rate of fire: 300 (Cleaning problem relatively insignificant in one hour)
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (500 yards): 1 plus $\sqrt{.5}$, or 1.707
5. Accuracy: .7
6. Reliability: .8

Calculation: 300 x .8 x 1.707 x .7 x .8: or 229

Springfield Rifle, M. 1903 (Magazine rifle)

1. Rate of fire: 600 (Cleaning problem relatively insignificant)
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (800 yards): 1 plus $\sqrt{.8}$, or 1.894
5. Accuracy: .9
6. Reliability: .95

Calculation: 600 x .8 x 1.894 x .9 x .95: or 778

World War I Machine Gun

1. Rate of fire: (Theoretically 24,000, reduced by 1/3 because of overheating consideration) 16,000
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (600 yards): 1 plus $\sqrt{.6}$, or 1.775
5. Accuracy: .7
6. Reliability: .8

Calculation: 16,000 x .8 x 1.775 x .7 x .8: or 12,700

World War II Machine Gun

1. Rate of fire: (Theoretically 30,000, reduced by 1/3 because of overheating considerations) 20,000
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (600 yards): 1 plus $\sqrt{.6}$, or 1.775
5. Accuracy: .7
6. Reliability: .9

Calculation: 20,000 x .8 x 1.775 x .7 x .9: or 17,900

16th Century 12-Pounder Cannon

1. Rate of fire: 5
2. Targets per strike: 12
3. Relative effect: 1
4. Effective range (500 yards): 1 plus $\sqrt{.5}$, or 1.707
5. Accuracy: .6
6. Reliability: .7

Calculation: 5 x 15 x 1.707 x .6 x .7: or 43

17th Century 12-Pounder Cannon

1. Rate of fire: 20
2. Targets per strike: 12
3. Relative effect: 1
4. Effective range (500 yards): 1.707
5. Accuracy: .7
6. Reliability: .8

Calculation: 20 x 12 x 1.707 x .7 x .8: or 229

Gribeauval 18th Century 12-Pounder Cannon

1. Rate of fire: 240
2. Targets per strike: 12 (This value is reasonable also for effects of early 19th Century black powder shell, or of spherical case or canister)
3. Relative effect: 1
4. Effective range (500 yards): 1.707
5. Accuracy: .9
6. Reliability: .9

Calculation: 240 x 12 x 1.707 x .9 x .9: or 3,970

French 75mm Gun

1. Rate of fire: 150
2. Targets per strike: area of burst (2700 square feet/4), or 675
3. Relative effect: 1
4. Effective range (8,000 yards): 1 plus $\sqrt{9}$, or 3.83
5. Accuracy: .95
6. Reliability: .95

Calculation: 150 x 675 x 3.83 x .95 x .95: or 340,000

155mm GPF

1. Rate of fire: 40
2. Targets per strike: 10,800 square feet/4, or 2,700
3. Relative effect: 1
4. Effective range (15,000 yards): 1 plus $\sqrt{15}$, or 4.87
5. Accuracy: .95
6. Reliability: .95

Calculation: 40 x 2,700 x 4.87 x .95 x .95: or 474,000

155mm Long Tom

1. Rate of fire: 40
2. Targets per strike: 10,800/4, or 2,700
3. Relative effect: 1
4. Effective range (20,000 yards): 1 plus $\sqrt{20}$, or 5.47
5. Accuracy: .95
6. Reliability: .95

Calculation: 40 x 2,700 x 5.47 x .95 x .95: or 533,000

105mm Howitzer, M-1

1. Rate of fire: 100
2. Target per strike: 6,750/4, or 1,690
3. Relative effect: 1
4. Effective range (12,000 yards): 1 plus $\sqrt{12}$, or 4.46
5. Accuracy: .9
6. Reliability: .95

Calculation: 100 x 1,690 x 4.46 x .9 x .95: or 644,000

(Note: This does not reflect the tactical versatility of the American 105mm howitzer due to its high selection of powder charges; this could provide a bonus factor perhaps as high as 10%, in comparison with weapons lacking such versatility.)

VT Fuze

It is assumed that the VT fuze will add 25% to the effectiveness of artillery fire on ground targets and 50% to the effectiveness of antiaircraft fire.

World War I Tank

(Assumes 2 machine guns, a rate of speed of 5 mph, and over 50% ability to survive .30 caliber machine-gun fire.)

1. Weapon lethality: 25,400
2. Mobility factor: $\sqrt{5}$, or 2.19
3. Punishment factor: 12,700

Calculation: 25,400 x 2.19, plus 12,700; or 55,600 plus 12,700: or 68,300

World War II Medium Tank

(Assumes 1 machine gun, plus one 3" gun; a rate of speed 30 mph; over 50% ability to survive 3" AT gun)

1. Weapon lethality: 17,900 plus 340,000, or 357,900
2. Mobility factor: $\sqrt{30}$, or 5.48
3. Punishment factor: 340,000

Calculation: 357,900 x 5.48 plus 340,000; or 1,963,000 plus 340,000: or 2,203,000

World War I Fighter-Bomber

(Assumes 1 machine gun, plus two 50-pound bombs with areas of burst of 10,000 square feet each; speed, 150 mph; over 50% ability to survive a .30 caliber machine gun)

1. Weapon lethality: 12,700, plus 20,000/4, or 17,700
2. Mobility factor: $\sqrt{150}$, or 12.25
3. Punishment factor: 12,700

Calculation: 17,700 x 12.25 plus 12,700: or 229,200

World War II Fighter-Bomber

(Assumes 8 machine guns, plus 2 100-pound bombs with an area of burst each of 15,000 square feet; rate of speed 400 mph; over 50% ability to survive a .30 caliber machine gun)

1. Weapon lethality: 17,900 x 8 plus 30,000/4, or 143,500 plus 7,500, or 151,000
2. Mobility factor: $\sqrt{400}$, or 20
3. Punishment factor: 17,900

Calculation: 151,000 x 20 plus 17,900; or 3,020,000 plus 17,900: or 3,037,900

V-2 Ballistic Missile

1. Rate of fire: 1
2. Targets per strike: 282,000 square feet/4, or 70,500
3. Relative effect: 1
4. Effective range (358,000 yards): 1 plus $\sqrt{358}$, or 19.1
5. Accuracy: .8 (arbitrary assumption)
6. Reliability: .8 (arbitrary assumption)

Calculation: 70,500 x 19.1 x .8 x .8: or 861,000

20 Kiloton Nuclear Weapon, Airburst

This calculation considers only the effect of blast of the weapon, without the factor of the delivery mechanism, and without consideration of thermal or radiation effects.

Area of effective burst: $7,920^2$ x pi, or 194,200,000

Targets per strike: 194,200,000/4, or 48,550,000

Note: A straight calculation of the effect of 2,000 pounds of TNT--approximately 100,000 Lethality Index--times 20,000 would have provided a result of 2,000,000,000, thus suggesting a possible "overkill" effect factor of approximately 40, with respect to high explosive.

One Megaton Nuclear Weapon, Airburst

(Same basis of calculation as above)

Area of effective burst: $(5.5 \times 5,280)^2$ x pi, or 2,649,000,000

Targets per strike: 2,649,000,000/4, or 661,500,000

Note: The straight calculation of 100,000 x 1,000,000 would have given a result of 100,000,000,000 suggesting a possible "overkill" effect factor of approximately 150, with respect to high explosive.

Summation

Listed below are the inherent or theoretical lethality indices which we have calculated for a number of significant types of weapons of history, from antiquity to the nuclear age. Attached as Enclosure 1 is a graphical representation of trends in the lethality of weapons over the course of history, based upon these indices, plotted logarithmically.

Aside from the potential value of the indices, one significant conclusion emerges from this exercise in quantification: Since lethality is in part a function of the number of targets a given weapon can attack in a given unit of time, tactical mobility, personnel competence and reliability, ease of maintenance, ability to replace crew casualties, and ammunition supply are all important variables, and a sharp improvement in any will be reflected in an increase in actual, or battlefield lethality.

Weapons	Lethality Index
Hand-to-hand (sword, pike, etc.)	20
Javelin	18
Ordinary bow	20
Longbow	34
Crossbow	32
Arquebus	10
17th Century musket	19
18th Century flintlock	47
Early 19th Century rifle	36
Mid-19th Century rifle with conoidal bullet	154
Late 19th Century breechloading rifle	229
Springfield Model 1903 rifle (magazine)	778
World War I machine gun	12,730
World War II machine gun	17,980
16th Century 12-pounder cannon	43
17th Century 12-pounder cannon	229
Gribeauval 18th Century 12-pounder cannon	3,970
French 75mm gun	340,000
155mm GPF	474,000
155mm "Long Tom"	533,000
105mm Howitzer, M-1	644,000
World War I tank	68,300
World War II medium tank	2,203,000
World War I fighter-bomber	229,200
World War II fighter-bomber	3,037,900
V-2 ballistic missile	861,000
20 Kiloton nuclear airburst	48,550,000
One megaton nuclear airburst	661,500,000

Appendix G

FIREPOWER CALCULATIONS BASED ON THEORETICAL WEAPON LETHALITY

Part One: Unit Firepower

US Infantry Division, 1943

Weapon	Index	Units	Total
Carbine, cal .30	619	5,262	3,257,178
Machinegun, cal .30 (hv)	6,709.5	90	603,855
Machinegun, cal .30 (lt)	3,220	67	215,740
Machinegun, cal .50	8,387	236	1,979,332
Submachinegun, cal .45	1,328	90	119,520
Gun, 57mm. (AT)	197,098	57	11,234,586
Howitzer, 105mm.	644,477	54	34,801,758
Howitzer, 155mm.	490,200	12	5,882,400
Launcher, rocket, 2.36"	86,611.5	557	48,242,884
Mortar, 60mm.	91,700	90	8,253,000
Mortar, 81mm.	245,000	54	13,230,000
Pistol, auto. cal.45	166	1,157	192,062
Rifle BAR	2,535	243	616,005
Rifle, cal .30M1	1,042.7	6,301	6,570,053
Rifle, cal .30M1903	777	217	168,609
Gun, 37mm.	51,300		
Car, armored (37mm. gun and LMG cal .30)	303,345	13	3,943,485
			139,310,467

US Infantry Regiment, 1943

Weapon	Index	Units	Total
Carbine, cal .30	619	853	528,007
Machinegun, cal .30 (hv)	6,709.5	24	161,028
Machinegun, cal .30 (lt)	3,220	18	57,960
Machinegun, cal .50	8,386.6	35	293,531
Submachinegun, cal .45	1,328		
Gun, 57mm. (AT)	197,098	18	3,547,764
Howitzer, 105mm.	644,477	6	3,866,862
Howitzer, 155mm.	490,200		
Launcher, rocket, 2.36"	86,611.5	112	9,700,488
Mortar, 60mm.	91,700	27	2,475,900
Mortar, 81mm.	245,000	18	4,410,000
Pistol, auto. cal .45	166	293	48,638
Rifle BAR	2,535	81	205,335
Rifle, cal .30M1	1,042.7	1,882	1,962,361
Rifle, cal .30M1903	777	27	20,979
			27,278,853

US Medium Tank Battalion, 1943

Weapon	Index	Units	Total
Carbine, cal .30	619	338	209,222
Gun, AT, SP, 37mm.	51,300	6	307,800
Gun, assault, SP, 37mm.	51,300	3	153,900
Machinegun, cal .50	8,387	3	25,161
Machinegun, cal .30	3,220	10	32,200
Submachinegun	1,328	143	189,904
Mortar, 81mm.	245,000	3	735,000
Pistol	166	304	50,464
Rifle, cal .30	1,042.7	13	135,551
Tank, medium	2,250,736	53	119,289,008*
Tank, light	340,000	17	5,780,000
			126,908,210**

*With 105mm. guns--143,154,590.

**With 105mm. guns--150,773,792

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US Tank Destroyer Battalion, 1943

Weapon	Index	Units	Total
Carbine, cal .30	619	534	330,546
Gun, 3" AT	342,428	36	12,327,408
Machinegun, cal .30 (lt)	3,220	35	112,700
Machinegun, cal .50 (hv)	8,387	54	452,898
Pistol	166	78	12,948
Rifle, cal .30	1,042.7	42	43,793
Launcher, rocket	86,612	62	5,369,944
			18,650,237

US Chemical Mortar Battalion, 1943

Weapon	Index	Units	Total
Mortar, 4.2"	392,958	12	4,715,496
Miscellaneous			400,000
			5,115,496

US Engineer (C) Battalion, 1943

Carbine	619	123	76,137
Machinegun (lt)	3,220	26	83,720
Machinegun (hv)	8,387	28	234,836
Submachinegun	1,328	48	63,744
Launcher, rocket	86,612	40	3,864,480
Pistol	166	7	1,162
Rifle	1,042.7	707	737,189
			5,061,268

Naval and Air Support Firepower, 1943

Weapon	Index	Units	Totals
1. Average Battleship firepower support			
Guns, 15"	3,271,337	8	26,170,696
Guns, 6"	601,668	20	12,033,360
			38,204,056
2. Average Heavy Cruiser firepower support			
Guns, 8"	421,070	10	4,210,700
Guns, 5"	672,117	20	13,442,340
			17,653,040
3. Average Light Cruiser firepower support			
Guns, 6"	543,005	12	6,516,060
Guns, 4"	834,587	20	16,691,740
			23,207,800
4. Average Destroyer firepower support			
Guns, 5"	672,117	8	5,376,936
5. Average Fleet Carrier support (½ efficiency)			
Fighter-aircraft	$\frac{3,037,900}{2}$	50	75,947,500
6. Average Escort Carrier support (½ efficiency)			
Fighter-aircraft	$\frac{3,037,900}{2}$	20	30,379,000
6. Fighter support, land-based, at Salerno was about ¼ efficiency, due to distance. Assume:			
	$\frac{3,037,900}{4}$	100	75,947,500

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German Infantry Division

Weapon	Index	Units	Total
Machinegun (lt)	3,760	527	1,981,520
Machinegun (hv)	8,051	116	933,916
Rifle, 7.92 (AT)	312	90	28,080
Gun, 75mm. (AT)	325,000	75	24,375,000
Rifle, infantry	670	13,899	9,312,330
Gun, 20mm. (AT)	25,650	11	282,150
Mortar, 50mm.	25,541	84	2,145,444
Mortar, 81mm.	276,531	58	16,038,798
Howitzer, infantry, 75mm.	234,532	20	4,690,640
Howitzer, infantry, 150mm.	316,778	6	1,900,668
Gun, 105mm.	577,125	4	2,309,500
Gun-howitzer, 150mm.	316,778	8	2,534,224
Gun-howitzer, 105mm.	526,382	36	18,949,752
			85,482,022

German Panzer Division

Weapon	Index	Units	Total
Infantry rifle	670	9,186	6,154,620
Pistol	166	3,317	550,622
Submachinegun	1,328	1,543	2,049,104
Machinegun (lt)	3,760	927/230	3,485,520
Machinegun (hv)	8,051	64	515,264
Gun, 28/20mm. (AT)	25,650	3	76,950
Gun, 37mm. (AT)	51,300	8	410,400
Gun, 75mm. (AT)	325,000	59	19,175,000
Gun, 20mm. (AA/AT)	25,650	32/6	820,800
Gun, 88mm. (AA/AT)	618,072	8	4,944,576
Tank gun, 75mm. long	407,546	52	(21,192,392)
Tank gun, 75mm. superlong	456,891	51	(23,301,441)
			(44,493,833)
Mortar, 81mm.	276,531	46	12,720,426
Howitzer, infantry, 75mm.	234,532	12	2,814,384
Gun, 105mm. recoilless	577,125	12	6,925,500
Gun-howitzer, 105mm.	526,382	12	6,316,584
Howitzer, 150mm.	316,778	18	5,702,004
Flamethrower	533	68	36,244
Howitzer, infantry, 150mm.	316,778	12	3,801,336
Mortar, 120mm.	492,480	16	7,879,680
Car, armored (lt)	24,365	18	438,570
Car, armored (hv)	169,218	6	1,015,308
Tank, Mk.IV with long 75mm. gun	2,417,758	52	125,723,416
Tank, Mk.V with superlong 75mm. gun	2,952,518	51	150,578,418
			362,134,726

Japanese Firepower--62nd Division

Weapon	Index	Units	Total
1. Rifle Company			
Machinegun (lt)	2,817	9	25,353
Mortar, 50mm.	61,135	9	550,215
Rifles	423	220	93,060
			668,628
2. Heavy Machinegun Company			
Machinegun (hv)	8,588	10	85,880
3. Infantry Gun Company			
Howitzer, infantry, 70mm.	126,000	2	252,000
Gun, 75mm.	349,979	2	699,958
			951,958
4. Independent Infantry Battalion A			
5 x #1.			3,343,140
1 x #2.			85,880
1 x #3.			951,958
			4,380,978
5. Independent Infantry Battalion B			
3 x #1.			2,005,884
1 x #2.			85,880
			2,091,764
6. Brigade			
1 x #5.			2,091,764
4 x #4.			17,523,912
			19,615,676
7. Divisional total firepower			
2 x #6.			39,231,352

Japanese Firepower--24th Division

8. Infantry Regiment

3 Infantry Battalions, #5.			6,275,292
1 Infantry gun company, #3.			951,958
Extra rifles, 500, @ 243			211,500
			7,438,750

9. 42nd Field artillery regiment

Guns, 75mm.	349,979	36	12,599,244
Howitzers, 105mm.	506,189	12	6,074,268
Rifles	423	2,000	846,000
LMG	2,817	30	84,510
			19,604,022

10. 24th Division Total firepower

3 x #8.			22,316,250
1 x #9.			19,604,022
Extra rifles	423	6,900	2,910,000
			44,830,272

US Infantry Division, 1950

Weapons	Index	Units	Total
Carbine, cal .30	690	5,508	3,800,520
Gun, 40mm., twin	123,120	32	3,939,840
Machinegun, cal .30 (hv)	6,709.5	36	241,542
Machinegun, cal .30 (lt)[2]	3,220	309	994,980
Machinegun, cal .50[2]	8,387	322	2,700,614
Machinegun, cal .50, multiple mount (4 guns)	25,548	32	817,536
Submachinegun, cal .45	1,328	970	1,288,160
Gun, 76mm.	407,546	9	(3,667,914)
Gun, 90mm.	618,071	135	(83,439,585)
Howitzer, 105mm.	644,477	54	34,801,758
Howitzer, 155mm.	490,200	18	8,823,600
Launcher, rocket, 3.5"	173,224	557	96,485,768
Mortar, 60mm.	91,700	81	7,427,700
Mortar, 81mm.	245,000	39	9,555,000
Mortar, 4.2"	392,958	36	14,146,488
Pistol, auto. cal .45	166	2,163	359,058
Rifle, cal .30M1	1,042.7	8,869	92,477,063
Rifle, cal .30M1C (sniper)	777	243	188,811
Rifle, auto. cal .30	2,535	250	633,750
Rifle, 57mm. M18	197,098	81	15,964,938
Rifle, 75mm. M20	220,495	39	8,599,305
Tank, medium, 76mm. gun	2,477,476	9	19,819,808
Tank, medium, 90mm. gun	3,530,101	135	476,563,635
			799,629,874

US Medium Tank Battalion, 1950

Weapon	Index	Units	Total
Carbine, cal .30	690	283	195,270
Machinegun, cal .30 (lt)	3,220	12	38,640
Machinegun, cal .50	8,387	13	109,031
Submachinegun, cal .45	1,328	159	211,152
Tank gun, 76mm.	407,546	2	815,092
Tank gun, 90mm.	618,071	69	42,646,899
Launcher, rocket, 3.5"	173,224	18	3,118,032
Pistol, auto. cal .45	166	357	59,262
Rifle, auto. cal .30	2,535	1	2,535
Rifle, cal .30M1	1,042.7	21	21,897
Tank, 76mm. gun	2,477,476	2	4,954,952
Tank, 90mm. gun	3,530,101	69	243,576,969
			295,749,731

North Korean Peoples Army Infantry Division

Weapon	Index	Units	Total
Rifle, Soviet M/N	751	6,986	5,245,000
SMG, Soviet PPSH	1,351	1,739	2,350,000
LMG, Soviet Degtarov	3,800	288	1,094,000
HMG, Soviet Maxim	8,000	135	1,080,000
AT Rifle 14, .5mm, Soviet	5,000	93	465,000
45mm. AT, Soviet	74,899	48	3,595,000
82mm. Mortar, Soviet	279,629	81	22,650,000
120mm. Mortar, Soviet	948,888	18	17,080,000
12.7mm. AAMG, Soviet	15,000	36	540,000
76mm. Gun, Soviet divisional gun	349,722	36	12,590,000
122mm. Howitzer, Soviet	650,000	12	7,800,000
37mm. AA, Soviet	50,000	12	600,000
			75,089,000

Appendix G

FIREPOWER CALCULATIONS BASED ON THEORETICAL WEAPON LETHALITY

Part Two: Lethality Indices

Lethality Indices
US WEAPONS, WORLD WAR II

Carbine, cal .30M1
1. Rate of fire: 1,000
2. Targets per strike: 1
3. Relative effect: .7
4. Effective range (150 yards): 1 plus $\sqrt{.15}$, or 1.387
5. Accuracy: .75
6. Reliability: .85

Calculation: 1,000 x 1 x .7 x 1.387 x .75 x .85: or 619

Machinegun, cal .30 (hv)
1. Rate of fire: 125
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (600 yards): 1 plus $\sqrt{.6}$, or 1.775
5. Accuracy: .7
6. Reliability: .9

Calculation: 125 x 1 x .8 x 1.775 x .7 x .9: or 6,709.5

Machinegun, cal .30 (lt)
1. Rate of fire: 3,600
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (600 yards): 1 plus $\sqrt{.6}$, or 1.775
5. Accuracy: .7
6. Reliability: .9

Calculation: 3,600 x 1 x .8 x 1.775 x .7 x .9: or 3,220

Machinegun, cal .50
1. Rate of fire: 7,500
2. Targets per strike: 1
3. Relative effect: 1
4. Effective range (600 yards): 1 plus $\sqrt{.6}$, or 1.775
5. Accuracy: .7
6. Reliability: .9

Calculation: 7,500 x 1 x 1 x 1.775 x .7 x .9: or 8,387

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2.1" Gun, 57mm. (AT)

1. Rate of fire: 120
2. Targets per strike: 765
3. Relative effect: 1
4. Effective range (1900 yards): 1 plus $\sqrt{1.9}$, or 2.379
5. Accuracy: .95
6. Reliability: .95

Calculation: 120 x 765 x 1 x 2.379 x .95 x .95: or 197,098

Pistol, auto. cal .45

1. Rate of fire: 600
2. Targets per strike: 1
3. Relative effect: .7
4. Effective range (50 yards): 1 plus $\sqrt{.05}$, or 1.24
5. Accuracy: .4
6. Reliability: .8

Calculation: 600 x 1 x .7 x 1.24 x .4 x .8: or 166

Rifle, BAR

1. Rate of fire: 3,000
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (600 yards): 1 plus $\sqrt{.6}$, or 1.775
5. Accuracy: .7
6. Reliability: .85

Calculation: 3000 x 1 x .8 x 1.775 x .85: or 2,535

Rifle, cal .30M1

1. Rate of fire: 960
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (600 yards): 1 plus $\sqrt{.6}$, or 1.775
5. Accuracy: .85
6. Reliability: .9

Calculation: 960 x 1 x .8 x 1.775 x .85 x .9: or 1,042.7

Rifle, cal .30M1903

1. Rate of fire: 600
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (800 yards): 1 plus $\sqrt{.8}$, or 1.894
5. Accuracy: .9
6. Reliability: .95

Calculation: 600 x 1 x .8 x 1.894 x .9 x .95: or 777

Antitank Gun, 37mm.

1. Rate of fire: 1,000
2. Targets per strike: 30
3. Relative effect: 1
4. Effective range (1000 yards): 1 plus $\sqrt{1}$, or 2
5. Accuracy: .95
6. Reliability: .9

Calculation: 1000 x 30 x 1 x 2 x .95 x .9: or <u>51,300</u>

Mortar, 4.2"

1. Rate of fire: 250
2. Targets per strike: 600
3. Relative effect: 1
4. Effective range (6000 yards): 1 plus $\sqrt{6}$, or 3.447
5. Accuracy: .8
6. Reliability: .95

Calculation: 250 x 600 x 1 x 3.447 x .8 x .95: or <u>392,958</u>

Mortar, 60mm. M2

1. Rate of fire: 350
2. Targets per strike: 259
3. Relative effect: 1
4. Effective range (1800 yards): 1 plus $\sqrt{1.8}$, or 1.42
5. Accuracy: .75
6. Reliability: .95

Calculation: 350 x 259 x 1 x 1.42 x .75 x .95: or <u>91,700</u>

Mortar, 81mm.

1. Rate of fire: 300
2. Targets per strike: 394
3. Relative effect: 1
4. Effective range (3000 yards): 1 plus $\sqrt{3}$, or 2.73
5. Accuracy: .8
6. Reliability: .95

Calculation: 300 x 394 x 1 x 2.73 x .8 x .95: or <u>245,000</u>

Submachinegun, cal .45

1. Rate of fire: 3,000
2. Targets per strike: 1
3. Relative effect: .7
4. Effective range (100 yards): 1 plus $\sqrt{.1}$, or 1.317
5. Accuracy: .6
6. Reliability: .8

Calculation: 3000 x 1 x .7 x 1.317 x .6 x .8: or <u>1,328</u>

Howitzer, 105mm.

1. Rate of fire: 100
2. Targets per strike: 1,690
3. Relative effect: 1
4. Effective range (1200 yards): 1 plus $\sqrt{12}$, or 4.46
5. Accuracy: .9
6. Reliability: .95

Calculation: 100 x 1690 x 1 x 4.46 x .9 x .95: or 644,477

Howitzer, 155mm.

1. Rate of fire: 40
2. Targets per strike: 2,720
3. Relative effect: 1
4. Effective range (16,000 yards): 1 plus $\sqrt{16}$, or 5
5. Accuracy: .95
6. Reliability: .95

Calculation: 40 x 2720 x 1 x 5 x .95 x .95: or 490,200

Launcher, rocket, 2.36"

1. Rate of fire: 240
2. Targets per strike: 324
3. Relative effect: 1
4. Effective range (300 yards): 1 plus $\sqrt{.3}$, or 1.547
5. Accuracy: .8
6. Reliability: .9

Calculation: 240 x 324 x 1 x 1.547 x .8 x .9: or 86,611.5

Car, armored, M8

(Assumes 1 37mm. gun, plus 1 LMG cal .30; a rate of speed of 30mph; over 50% ability to survive .50 cal. machinegun)

1. Weapon lethality: 51,300 plus 2524.4, or 53,824.4
2. Mobility factor: $\sqrt{30}$, or 5.48
3. Punishment factor: 8,386.6

Calculation: 53,824.4 x 5.48 plus 8,386.6: or 303,345

Medium Tank

(Assumes 1 75mm. gun, cal 40, plus 2 .30 LMG; rate of speed 20 mph; over 50% ability to survive 75mm. gun)

1. Weapon lethality: 342,428 plus 3220 x 2, or 348,868
2. Mobility factor: $\sqrt{30}$, or 5.47
3. Punishment factor: 342,428

Calculation: 348,868 x 5.47 plus 342,428: or 2,250,736

Light Tanks

(Assumes 1 37mm. M6 cal .53, plus 2 .30LMGs; a rate of speed 25mph; over 50% ability to survive 37mm. gun)

1. Weapon lethality: 51,300 plus 3220 x 2, or 57,740
2. Mobility factor: $\sqrt{25}$, or 5
3. Punishment factor: 51,300

Calculation: 57,740 x 5 plus 51,300: or 340,000

13" Naval Gun

Rate of fire: 12

2. Targets per strike: 30,375
3. Relative effect: 1
4. Effective range (34,000 yards): 1 plus $\sqrt{34}$, or 6.83
5. Accuracy: .95
6. Reliability: .95

Calculation: 12 x 30,375 x 1 x 6.83 x .95 x .95: or 2,246,805

12" Naval Gun

1. Rate of fire: 12
2. Targets per strike: 216,000
3. Relative effect: 1
4. Effective range (32,000 yards): 1 plus $\sqrt{32}$, or 6.65
5. Accuracy: .95
6. Reliability: .95

Calculation: 12 x 216,000 x 1 x 6.65 x .95 x .95: or 1,555,621

11" Naval Gun

1. Rate of fire: 12
2. Targets per strike: 16,895
3. Relative effect: 1
4. Effective range (30,000 yards): 1 plus $\sqrt{30}$, or 6.48
5. Accuracy: .95
6. Reliability: .95

Calculation: 12 x 16,895 x 6.48 x .95 x .95: or 1,184,261

16" Naval Gun

1. Rate of fire: 10
2. Targets per strike: 675,000
3. Relative effect: 1
4. Effective range (40,000 yards): 1 plus $\sqrt{40}$, or 7.33
5. Accuracy: .95
6. Reliability: .95

Calculation: 10 x 675,000 x 1 x 7.33 x .95 x .95: or 4,465,345

15" Naval Gun

1. Rate of fire: 10
2. Targets per strike: 506,250
3. Relative effect: 1
4. Effective range (38,000 yards): 1 plus $\sqrt{38}$, or 7.16
5. Accuracy: .95
6. Reliability: .95

Calculation: 10 x 506,250 x 1 x 7.16 x .95 x .95: or 3,271,337

14" Naval Gun

1. Rate of fire: 10
2. Targets per strike: 360,000
3. Relative effect: 1
4. Effective range (36,000 yards): 1 plus $\sqrt{36}$, or 7
5. Accuracy: .95
6. Reliability: .95

Calculation: 10 x 360,000 x 1 x 7 x .95 x .95: or 2,274,300

5" Naval Gun

1. Rate of fire: 60
2. Targets per strike: 2014
3. Relative effect: 1
4. Effective range (24,000 yards): 1 plus $\sqrt{24}$, or 5.9
5. Accuracy: .95
6. Reliability: .95

Calculation: 60 x 2014 x 1 x 5.9 x .95 x .95: or 672,117

4" Naval Gun

1. Rate of fire: 100
2. Targets per strike: 1688
3. Relative effect: 1
4. Effective range (20,000 yards): 1 plus $\sqrt{20}$, or 5.48
5. Accuracy: .95
6. Reliability: .95

Calculation: 100 x 1688 x 1 x 5.48 x .95 x .95: or 834,587

10" Naval Gun

1. Rate of fire: 15
2. Targets per strike: 11,250
3. Relative effect: 1
4. Effective range (30,000 yards): 1 plus $\sqrt{30}$, or 6.48
5. Accuracy: .95
6. Reliability: .95

Calculation: 15 x 11,250 x 1 x 6.48 x .95 x .95: or 986,884

8" Naval Gun

1. Rate of fire: 20
2. Targets per strike: 3600
3. Relative effect: 1
4. Effective range (30,000 yards): 1 plus $\sqrt{30}$, or 6.48
5. Accuracy: .95
6. Reliability: .95

Calculation: 20 x 3600 x 1 x 6.48 x .95 x .95: or 421,070

6" Naval Gun

1. Rate of fire: 40
2. Targets per strike: 2430
3. Relative effect: 1
4. Effective range (27,000 yards): 1 plus $\sqrt{27}$, or 6.19
5. Accuracy: .95
6. Reliability: .95

Calculation: 40 x 2430 x 1 x 6.19 x .95 x .95: or 543,005

Lethality Indices
US WEAPONS, KOREAN WAR

AT Gun, 57mm. M18

1. Rate of fire: 120
2. Targets per strike: 765
3. Relative effect: 1
4. Effective range (1900 yards): 1 plus $\sqrt{1.9}$, or 2.379
5. Accuracy: .95
6. Reliability: .95

Calculation: 120 x 765 x 1 x 2.379 x .95 x .95: or 197,098

Rifle, cal 30M1C

1. Rate of fire: 600
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (800 yards): 1 plus $\sqrt{.8}$, or 1.894
5. Accuracy: .9
6. Reliability: .95

Calculation: 600 x 1 x .8 x 1.894 x .9 x .95: or 777

Gun, 75mm. M20

1. Rate of fire: 150
2. Targets per strike: 675
3. Relative effect: 1
4. Effective range (2000 yards): 1 plus $\sqrt{2}$, or 2.413
5. Accuracy: .95
6. Reliability: .95

Calculation: 150 x 675 x 1 x 2.413 x .95 x .95: or 220,495

Carbine, cal 30M2

1. Rate of fire: 1000
2. Targets per strike: 1
3. Relative effect: .7
4. Effective range (300 yards): 1 plus $\sqrt{.3}$, or 1.547
5. Accuracy: .75
6. Reliability: .85

Calculation: 1000 x 1 x .7 x 1.547 x .75 x .85: or 690

Gun, 40mm. twin

1. Rate of fire: 1000
2. Targets per strike: 72
3. Relative effect: 1
4. Effective range (1000 yards): 1 plus $\sqrt{1}$, or 2
5. Accuracy: .95
6. Reliability: .9

Calculation: 1000 x 72 x 1 x 2 x .95 x .9: or 123,120

Submachinegun, cal .45M3A1

1. Rate of fire: 3000
2. Targets per strike: 1
3. Relative effect: .7
4. Effective range (100 yards): 1 plus $\sqrt{.1}$, or 1.317
5. Accuracy: .6
6. Reliability: .8

Calculation: 3000 x 1 x .7 x 1.317 x .6 x .8: or 1328

Gun, 76mm.

1. Rate of fire: 150
2. Targets per strike: 675
3. Relative effect: 1
4. Effective range (12,000 yards): 1 plus $\sqrt{12}$, or 4.46
5. Accuracy: .95
6. Reliability: .95

Calculation: 150 x 675 x 1 x 4.46 x .95 x .95: or 407,546

Gun, 90mm.

1. Rate of fire: 125
2. Targets per strike: 1125
3. Relative effect: 1
4. Effective range (15,000 yards): 1 plus $\sqrt{15}$, or 4.87
5. Accuracy: .95
6. Reliability: .95

Calculation: 125 x 1125 x 1 x 4.87 x .95 x .95: or 618,071

Launcher, rocket, 3.5"

1. Rate of fire: 240
2. Targets per strike: 648
3. Relative effect: 1
4. Effective range (300 yards): 1 plus $\sqrt{.3}$, or 1.547
5. Accuracy: .8
6. Reliability: .9

Calculation: 240 x 648 x 1 x 1.547 x .8 x .9: or 173,224

Mortar, 4.2"

1. Rate of fire: 250
2. Targets per strike: 600
3. Relative effect: 1
4. Effective range (6000 yards): 1 plus $\sqrt{6}$, or 3.447
5. Accuracy: .8
6. Reliability: .95

Calculation: 250 x 600 x 1 x 3.447 x .8 x .95: or 392,958

Medium Tank, M4A3E8

(Assumes 1 76mm. gun, plus 2 .30LMGs; a rate of speed 25 mph; over 50% ability to survive 76mm. gun)

1. Weapon lethality: 407,546 plus 3220 x 2, or 413,896
2. Mobility factor: $\sqrt{25}$, or 5
3. Punishment factor: 407,546

Calculation: 413,986 x 5 plus 407,546: or 2,477,476

Medium Tank, M26

(Assumes 1 90mm. gun, plus 2 .30LMGs; a rate of speed of 25mph; over 50% ability to survive 76mm. gun)

1. Weapon lethality: 618,071 plus 3220 x 2, or 624,511
2. Mobility factor: $\sqrt{25}$, or 5
3. Punishment factor: 407,546

Calculation: 624,511 x 5 plus 407,546: or 3,530,101

Lethality Indices
GERMAN WEAPONS, WORLD WAR II

Machinegun, MG34, 7.92mm. (hv)
1. Rate of fire: 9000
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (600 yards): 1 plus $\sqrt{.6}$, or 1.775
5. Accuracy: .7
6. Reliability: .9

Calculation: 9000 x 1 x .8 x 1.775 x .7 x .9: or 8051

Machinegun (lt)
1. Rate of fire: 4200
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (600 yards): 1 plus $\sqrt{.6}$, or 1.775
5. Accuracy: .7
6. Reliability: .9

Calculation: 4200 x 1 x .8 x 1.775 x .7 x .9: or 3760

Antitank Rifle, 7.92mm.
1. Rate of fire: 400
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (300 yards): 1 plus $\sqrt{.3}$, or 1.547
5. Accuracy: .7
6. Reliability: .9

Calculation: 400 x 1 x .8 x 1.547 x .7 x .9: or 312

Infantry Rifle
1. Rate of fire: 600
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (400 yards): 1 plus $\sqrt{.4}$, or 1.633
5. Accuracy: .9
6. Reliability: .95

Calculation: 600 x 1 x .8 x 1.633 x .9 x .95: or 670

Mortar, 50mm.

1. Rate of fire: 500
2. Targets per strike: 450
3. Relative effect: 1
4. Effective range (500 yards): 1 plus $\sqrt{.5}$, or 1.707
5. Accuracy: .7
6. Reliability: .95

Calculation: 500 x 450 x 1 x 1.707 x .7 x .95: or 25,541

Mortar, 120mm.

1. Rate of fire: 200
2. Targets per strike: 1000
3. Relative effect: 1
4. Effective range (5000 yards): 1 plus $\sqrt{5}$, or 3.24
5. Accuracy: .8
6. Reliability: .95

Calculation: 200 x 1000 x 1 x 3.24 x .8 x .95: or 492,480

Mortar, 80mm.

1. Rate of fire: 300
2. Targets per strike: 625
3. Relative effect: 1
4. Effective range (1800 yards): 1 plus $\sqrt{1.8}$, or 2.341
5. Accuracy: .7
6. Reliability: .9

Calculation: 300 x 625 x 1 x 2.341 x .7 x .9: or 276,531

Flamethrower

1. Rate of fire: 100
2. Targets per strike: 5
3. Relative effect: 1
4. Effective range (100 yards): 1 plus $\sqrt{.1}$, or 1.316
5. Accuracy: .9
6. Reliability: .9

Calculation: 100 x 5 x 1 x 1.316 x .9 x .9: or 533

Howitzer, 75mm. Infantry, 1G18

1. Rate of fire: 150
2. Targets per strike: 675
3. Relative effect: 1
4. Effective range (3000 yards): 1 plus $\sqrt{3}$, or 2.73
5. Accuracy: .9
6. Reliability: .95

Calculation: 150 x 675 x 1 x 2.73 x .9 x .9: or 234,532

Howitzer, 150mm. Infantry, 1G33

1. Rate of fire: 50
2. Targets per strike: 2375
3. Relative effect: 1
4. Effective range (4500 yards): 1 plus $\sqrt{4.5}$, or 3.12
5. Accuracy: .9
6. Reliability: .95

Calculation: 50 x 2375 x 1 x 3.12 x .9 x .95: or 316,778

Gun-Howitzer (recoilless gun), 105mm. LG40

1. Rate of fire: 100
2. Targets per strike: 1687.5
3. Relative effect: 1
4. Effective range (7000 yards): 1 plus $\sqrt{7}$, or 3.649
5. Accuracy: .9
6. Reliability: .95

Calculation: 100 x 1687.5 x 1 x 3.649 x .9 x .95: or 526,382

Gun, 105mm. (recoilless airborne) LG42

1. Rate of fire: 100
2. Targets per strike: 1687.5
3. Relative effect: 1
4. Effective range (7000 yards): 1 plus $\sqrt{7}$, or 3.649
5. Accuracy: .9
6. Reliability: .95

Calculation: 100 x 1687.5 x 3.649 x .9 x .95: or 526,382

Gun, 105mm. (recoilless) LG43

1. Rate of fire: 100
2. Targets per strike: 1687.5
3. Relative effect: 1
4. Effective range (9000 yards): 1 plus $\sqrt{9}$, or 4
5. Accuracy: .9
6. Reliability: .95

Calculation: 100 x 1687.5 x 1 x 4 x .9 x .95: or 577,125

Gun, 88mm. (AA/AT)

1. Rate of fire: 125
2. Targets per strike: 1125
3. Relative effect: 1
4. Effective range (15,000 yards): 1 plus $\sqrt{15}$, or 4.87
5. Accuracy: .95
6. Reliability: .95

Calculation: 125 x 1125 x 1 x 4.87 x .95 x .95: or 618,072

Tank Gun, 20mm.

1. Rate of fire: 1000
2. Targets per strike: 15
3. Relative effect: 1
4. Effective range (1000 yards): 1 plus $\sqrt{1}$, or 2
5. Accuracy: .95
6. Reliability: .9

Calculation: 1000 x 15 x 1 x 2 x .95 x .9: or 25,650

Antitank Gun, 28/20mm.

1. Rate of fire: 1000
2. Targets per strike: 15
3. Relative effect: 1
4. Effective range (1000 yards): 1 plus $\sqrt{1}$, or 2
5. Accuracy: .95
6. Reliability: .9

Calculation: 1000 x 15 x 1 x 2 x .95 x .9: or 25,650

Antitank Gun, 37mm.

1. Rate of fire: 1000
2. Targets per strike: 30
3. Relative effect: 1
4. Effective range (1000 yards): 1 plus $\sqrt{1}$, or 2
5. Accuracy: .95
6. Reliability: .9

Calculation: 1000 x 30 x 1 x 2 x .95 x .9: or 51,300

Gun, 20mm. (AA/AT)

1. Rate of fire: 1000
2. Targets per strike: 30
3. Relative effect: 1
4. Effective range (1000 yards): 1 plus $\sqrt{1}$, or 2
5. Accuracy: .95
6. Reliability: .9

Calculation: 1000 x 15 x 1 x 2 x .95 x .9: or 25,650

Tank Gun, 75mm. (long)

1. Rate of fire: 150
2. Targets per strike: 675
3. Relative effect: 1
4. Effective range (12,000 yards): 1 plus $\sqrt{12}$, or 4.46
5. Accuracy: .95
6. Reliability: .95

Calculation: 150 x 675 x 1 x 4.46 x .95 x .95: or 407,546

Tank Gun, 75mm. (short)

1. Rate of fire: 150
2. Targets per strike: 675
3. Relative effect: 1
4. Effective range (6550 yards): 1 plus $\sqrt{6.55}$, or 3.56
5. Accuracy: .95
6. Reliability: .95

Calculation: 150 x 675 x 1 x 3.56 x .95 x .95: or 325,000

Tank Gun, 75mm. (superlong)

1. Rate of fire: 150
2. Targets per strike: 675
3. Relative effect: 1
4. Effective range (16,000 yards): 1 plus $\sqrt{16}$, or 5
5. Accuracy: .95
6. Reliability: .95

Calculation: 150 x 675 x 1 x 5 x .95 x .95: or 456,891

Tank Gun, 88mm.

1. Rate of fire: 125
2. Targets per strike: 1125
3. Relative effect: 1
4. Effective range (15,000 yards): 1 plus $\sqrt{15}$, or 4.87
5. Accuracy: .95
6. Reliability: .95

Calculation: 125 x 1125 x 1 x 4.87 x .95 x .95: or 618,072

Car, armored (heavy)

(Assumes 1 7.92mm. g u n , plus 1 20mm. g u n ; a rate of speed 30mph; over 50% ability to survive a .50 cal. machinegun)

1. Weapon lethality: 3760 plus 25,650, or 29,410
2. Mobility factor: $\sqrt{30}$, or 5.48
3. Punishment factor: 8051

Calculation: 29,410 x 5.48 plus 8051: or 169,218

Car, armored (light)

(Assumes 1 7.92mm g u n , a rate of speed 30mph; over 50% ability to survive light machinegun)

1. Weapon lethality: 3760
2. Mobility factor: $\sqrt{30}$, or 5.48
3. Punishment factor: 3760

Calculation: 3760 x 5.48 plus 3760: or 24,365

Panzer Kw. IV

(Assumes 1 75mm. long gun, plus 2 7.92mm. gun; rate of speed 25mph; over 50% ability to survive French 75 tank)

1. Weapon lethality: 407,546 plus 3760 x 2, or 415,066
2. Mobility factor: $\sqrt{25}$, or 5
3. Punishment factor: 342,428

Calculation: 415,066 x 5 plus 342,428: or 2,417,758

Panzer Kw. V Panther

(Assumes 1 75mm. superlong gun, plus 2 7.92 gun; a rate of speed 30mph; over 50% ability to survive long 75mm. gun)

1. Weapon lethality: 464,411
2. Mobility factor: $\sqrt{30}$, or 5.48
3. Punishment factor: 407,546

Calculation: 464,411 x 5.48 plus 464,411: or 2,952,518

Lethality Indices

JAPANESE WEAPONS, WORLD WAR II

20mm. (AA)

1. Rate of fire: 1000
2. Targets per strike: 15
3. Relative effect: 1
4. Effective range (1000 yards): 1 plus $\sqrt{1}$, or 2
5. Accuracy: .95
6. Reliability: .9

Calculation: 1000 x 15 x 1 x 2 x .95 x .9: or 25,650

Rifle, 6.5mm. M38

1. Rate of fire: 600
2. Targets per strike: 1
3. Relative effect: .6
4. Effective range (500 yards): 1 plus $\sqrt{.5}$, or 1.632
5. Accuracy: .8
6. Reliability: .9

Calculation: 600 x 1 x .6 x 1.632 x .8 x .9: or 423

Pistol, 1893 Smith and Wessen

1. Rate of fire: 600
2. Targets per strike: 1
3. Relative effect: .7
4. Effective range (50 yards): 1 plus $\sqrt{.05}$, or 1.24
5. Accuracy: .4
6. Reliability: .8

Calculation: 600 x 1 x .7 x 1.24 x .4 x .8: or 167

Machinegun, 6.5mm. M11 (lt)

1. Rate of fire: 4200
2. Targets per strike: 1
3. Relative effect: .70
4. Effective range (600 yards): 1 plus $\sqrt{.6}$, or 1.775
5. Accuracy: .6
6. Reliability: .9

Calculation: 4200 x 1 x .70 x 1.775 x .6 x .9: or 2817

Machinegun, 7.7mm. M92 (hv)

1. Rate of fire: 9600
2. Targets per strike: 1
3. Relative effect: .8
4. Effective range (600 yards): 1 plus $\sqrt{.6}$, or 1.775
5. Accuracy: .7
6. Reliability: .9

Calculation: 9600 x 1 x .8 x 1.775 x .7 x .9: or 8588

Gun, 37mm. M11

1. Rate of fire: 1000
2. Targets per strike: 27
3. Relative effect: 1
4. Effective range (1000 yards): 1 plus $\sqrt{1}$, or 2
5. Accuracy: .9
6. Reliability: .9

Calculation: 1000 x 27 x 1 x 2 x .9 x .9: or 43,740

Gun, 75mm. M41 (horse drawn or pack)

1. Rate of fire: 150
2. Targets per strike: 675
3. Relative effect: 1
4. Effective range (8,000 yards): 1 plus $\sqrt{8}$, or 3.83
5. Accuracy: .95
6. Reliability: .95

Calculation: 150 x 675 x 1 x 3.83 x .95 x .95: or 349,979

Gun, 75mm. M90

1. Rate of fire: 150
2. Targets per strike: 675
3. Relative effect: 1
4. Effective range (12,000 yards): 1 plus $\sqrt{12}$, or 4.46
5. Accuracy: .95
6. Reliability: .95

Calculation: 150 x 675 x 1 x 4.46 x .95 x .95: or 407,546

Howitzer, 105mm. M91 (1931)

1. Rate of fire: 100
2. Targets per strike: 1690
3. Relative effect: 1
4. Effective range (10,000 yards): 1 plus $\sqrt{10}$, or 4.16
5. Accuracy: .8
6. Reliability: .9

Calculation: 100 x 1690 x 1 x 4.16 x .8 x .9: or 506,189

Howitzer, 70mm.

1. Rate of fire: 200
2. Targets per strike: 500
3. Relative effect: 1
4. Effective range (1000 yards): 1 plus $\sqrt{1}$, or 2
5. Accuracy: .7
6. Reliability: .9

Calculation: 200 x 500 x 1 x 2 x .7 x .9: or 126,000

Mortar, 50mm.

1. Rate of fire: 350
2. Targets per strike: 172.6
3. Relative effect: 1
4. Effective range (1800 yards): 1 plus $\sqrt{1.8}$, or 1.42
5. Accuracy: .75
6. Reliability: .95

Calculation: 350 x 172.6 x 1 x 1.42 x .75 x .95: or 61,133

Howitzer, 150mm.

1. Rate of fire: 40
2. Targets per strike: 2500
3. Relative effect: 1
4. Effective range (7000 yards): 1 plus $\sqrt{7}$, or 3.65
5. Accuracy: .85
6. Reliability: .9

Calculation: 40 x 2500 x 1 x 3.65 x .85 x .9: or 279,225

Gun, 150mm.

1. Rate of fire: 40
2. Targets per strike: 2700
3. Relative effect: 1
4. Effective range (16,000 yards): 1 plus $\sqrt{16}$, or 5
5. Accuracy: .95
6. Reliability: .95

Calculation: 40 x 2700 x 1 x 5 x .95 x .95: or 487,350

Mortar, 81mm.

1. Rate of fire: 300
2. Targets per strike: 394
3. Relative effect: 1
4. Effective range (3000 yards): 1 plus $\sqrt{3}$, or 2.73
5. Accuracy: .8
6. Reliability: .95

Calculation: 300 x 394 x 1 x 2.73 x .8 x .95: or 245,000

Mortar, 320mm.

1. Rate of fire: 25
2. Targets per strike: 540,000
3. Relative effect: 1
4. Effective range (5000 yards): 1 plus $\sqrt{5}$, or 3.23
5. Accuracy: .7
6. Reliability: .9

Calculation: 25 x 540,000 x 1 x 3.23 x .7 x .9: or 1,098,846